May 18, 2020

Smoky Canyon
Draft Feasibility Study Technical Memorandum #2

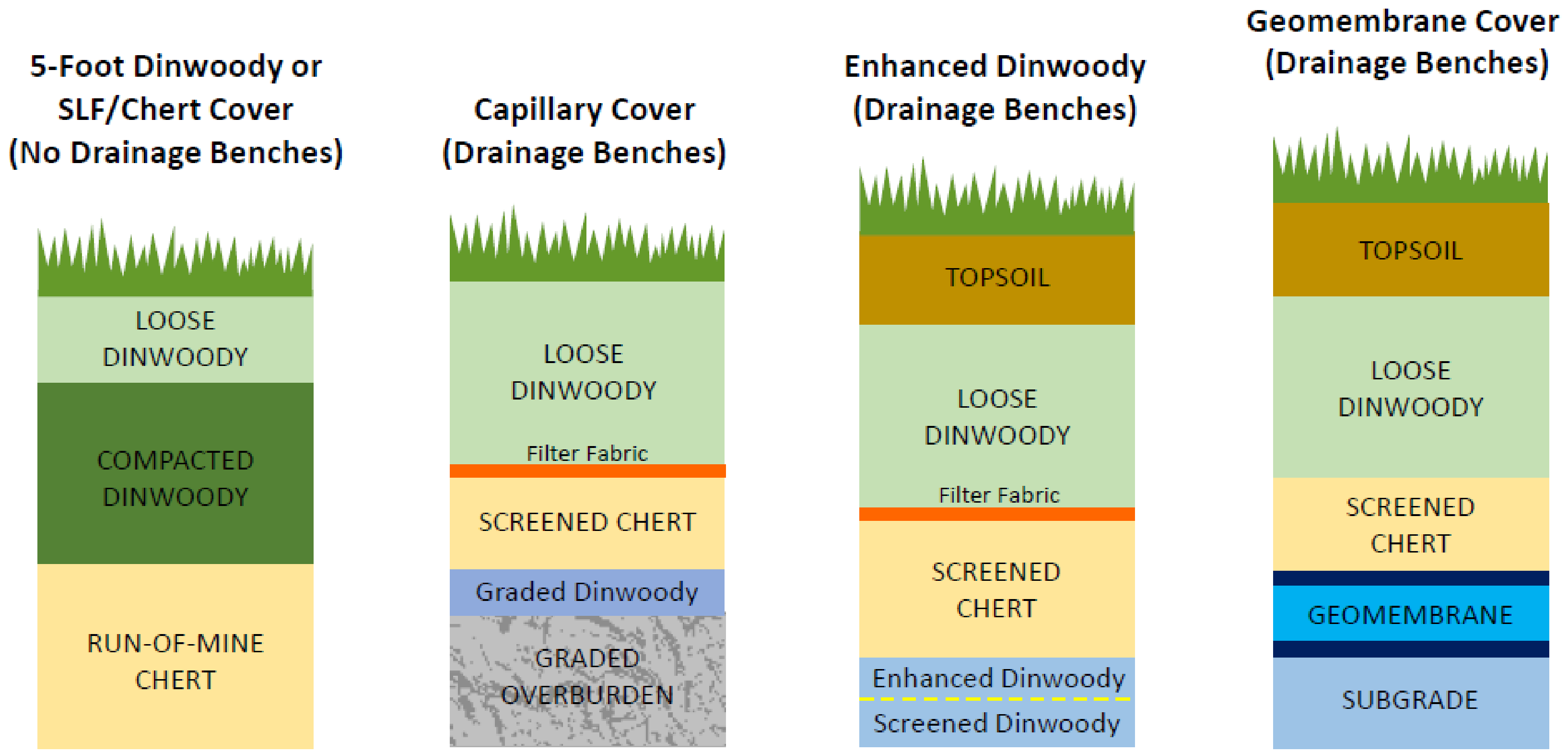
Meeting Goals

- Foster communication to streamline Feasibility Study process
- Simplot to present key elements of draft document
- Discuss any questions from Agencies

Screening of Remedial Alternatives

Wells Formation Groundwater	Surface Water	Alluvial Groundwater	Soils and Solids
WG-1 No Further Action	SW-1 No Further Action	AG-1 No Further Action	S-1 – No Further Action
WG-2 Monitored Natural Attenuation (MNA)	SW-2 5-Foot Dinwoody or Salt Lake Formation/Chert Covers	AG-2 Monitored Natural Attenuation (MNA)	S-2 Rock Covers on Soils in Seep and Riparian Areas
WG-3 Institutional Controls (ICs)	SW-3 Capillary Covers	AG-3 Institutional Controls (ICs) and MNA	S-3 2-Foot Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas
WG-4 5-Foot Dinwoody or Salt Lake Formation/Chert Covers, ICs and MNA	SW-4 Enhanced Dinwoody Covers	AG-4 Permeable Reactive Barrier (PRB), ICs and MNA	S-4 5-Foot Dinwoody or Salt Lake Formation/Chert Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas
WG-5 Capillary Covers, ICs and MNA	SW-5 Geomembrane Covers		
WG-6 Enhanced Dinwoody Covers, ICs and MNA	SW-6 Treatment of Water Discharging at Hoopes Spring		
WG-7 Geomembrane Covers, ICs and MNA			
Carried Forward Into the Detailed Analysis			

S:\JOBS\SMOKY\CERCLA\FS\FSTM2\FIGURES\APRILDRAFT\SECTION2



J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-7

PROFILES OF COVER ALTERNATIVES

DATE: APRIL 2020
BY: ASF FOR: ACK

FORMATION ENVIRONMENTAL

DRAFT

Cover Performance and Cost per Acre

Cover Type	Long-Term Average Percolation (in/yr)	Infiltration Reduction Relative to Exposed Overburden Pile[1]	Cost/Acre
Synthetic	0	100%	$240K
Enhanced Dinwoody	0.7	95%	$195K
Capillary	5.7	58%	$107K
5-Foot Dinwoody or Salt Lake Formation/Chert Covers	10.4	38%	$64K

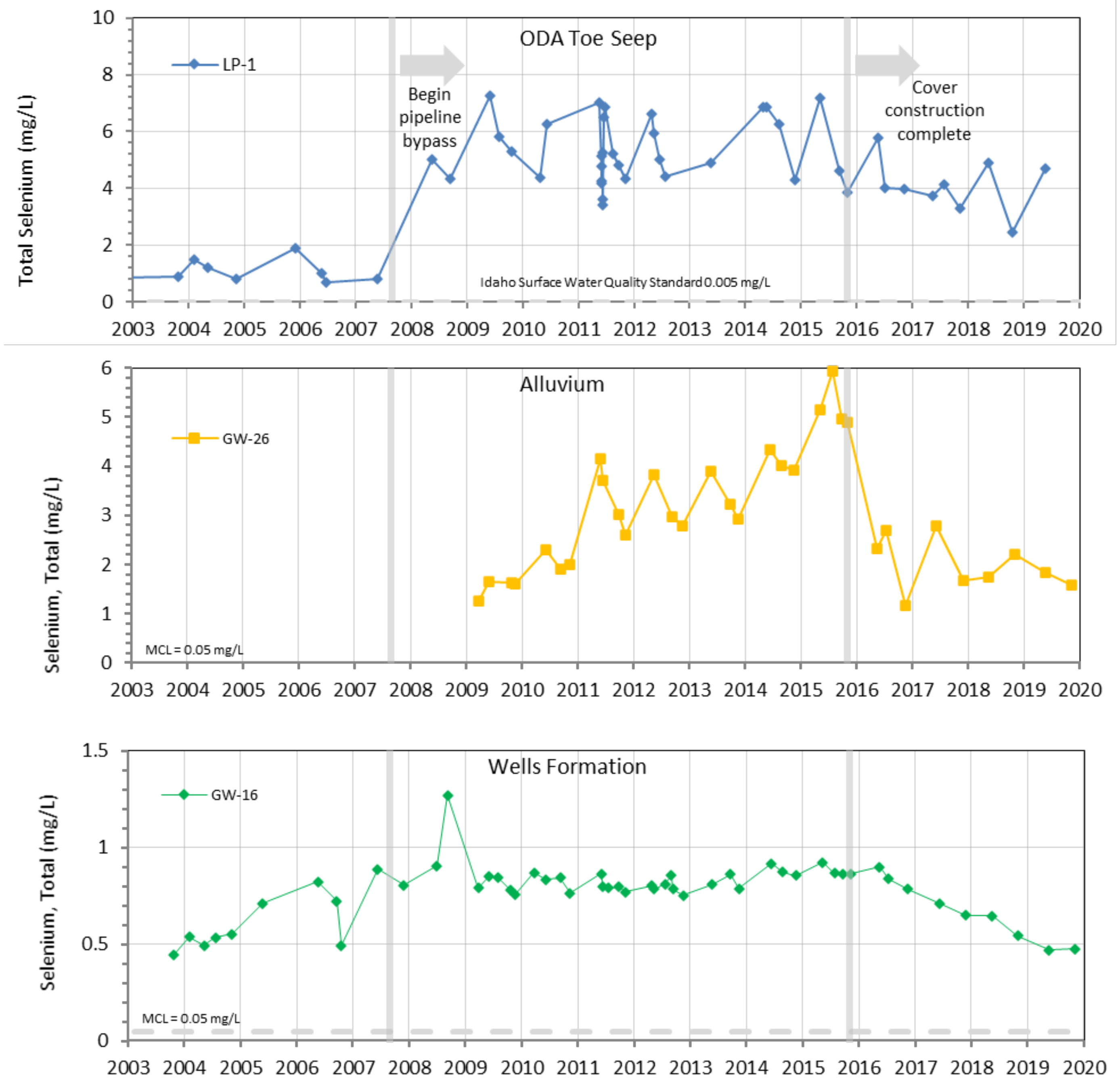
[1] Estimated average infiltration rate for the Exposed Overburden Pile is 14.6 in/yr.

Key Elements of the Detailed and Comparative Analysis

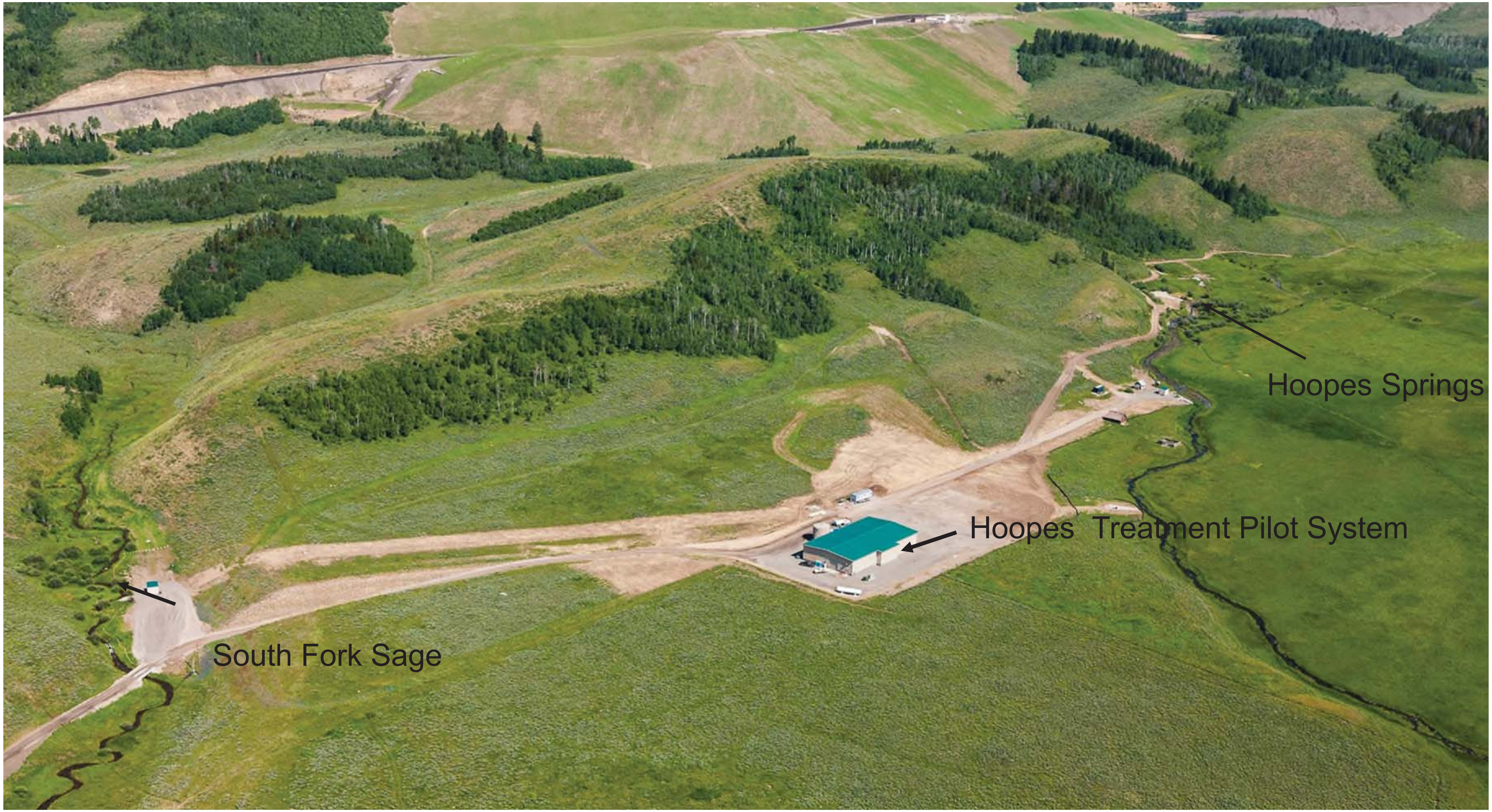
Pole Canyon NTCRAs

Pole Canyon NTCRAs

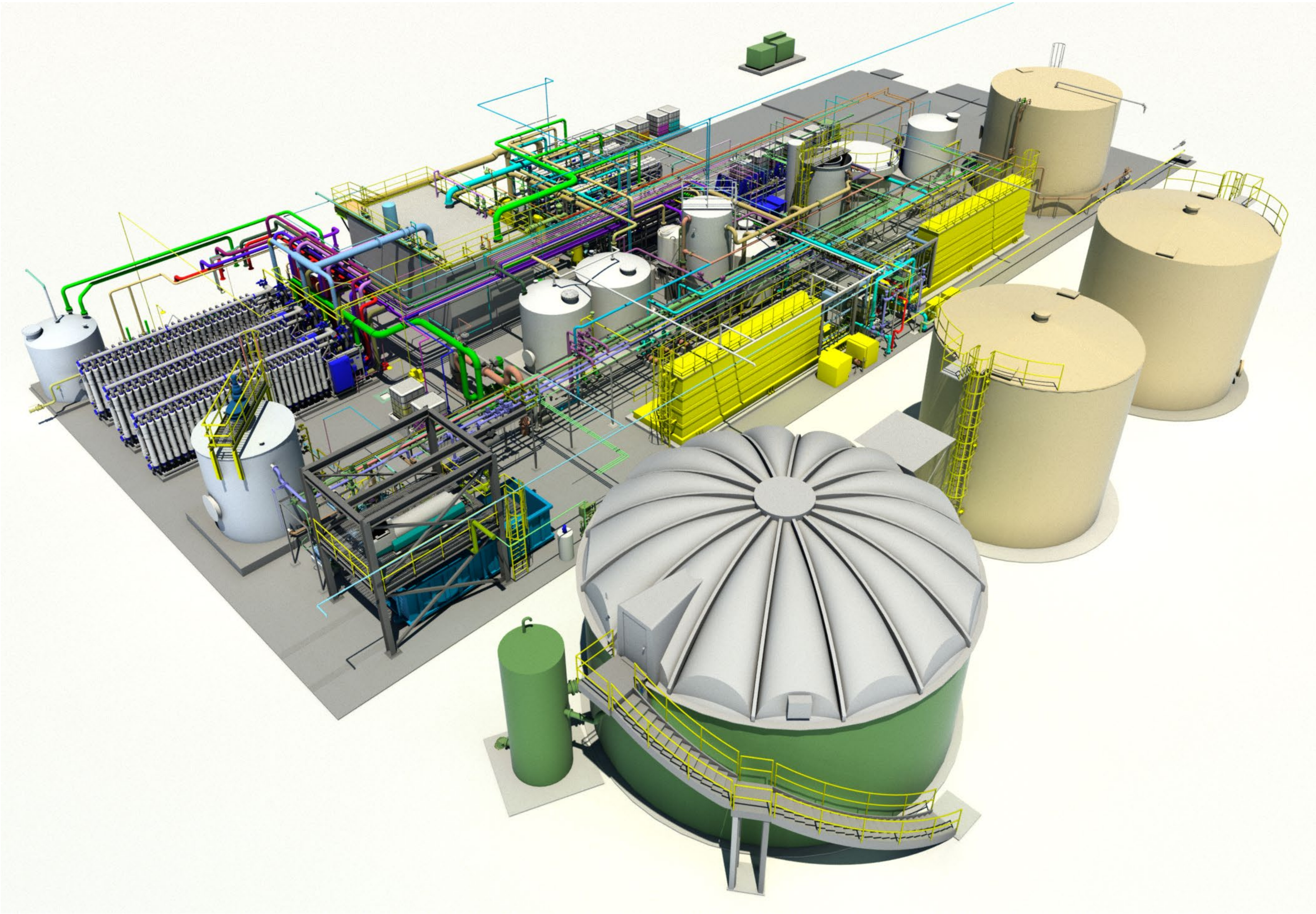
- "2006 NTCRA"
  - Pole Canyon Creek diversion pipeline
  - Infiltration basin upstream of the ODA
  - Run-on control channel
- "2013 NTRCA"
  - Dinwoody/chert cover on ODA
  - Storm water run-on/runoff controls


ODA Toe Seep
LP-1
Begin pipeline bypass
Cover construction complete
Idaho Surface Water Quality Standard 0.005 mg/L
Total Selenium (mg/L)
Alluvium
GW-26
MCL = 0.05 mg/L
Selenium, Total (mg/L)
Wells Formation
GW-16
MCL = 0.05 mg/L
Selenium, Total (mg/L)

Treatment of Water at Hoopes Springs

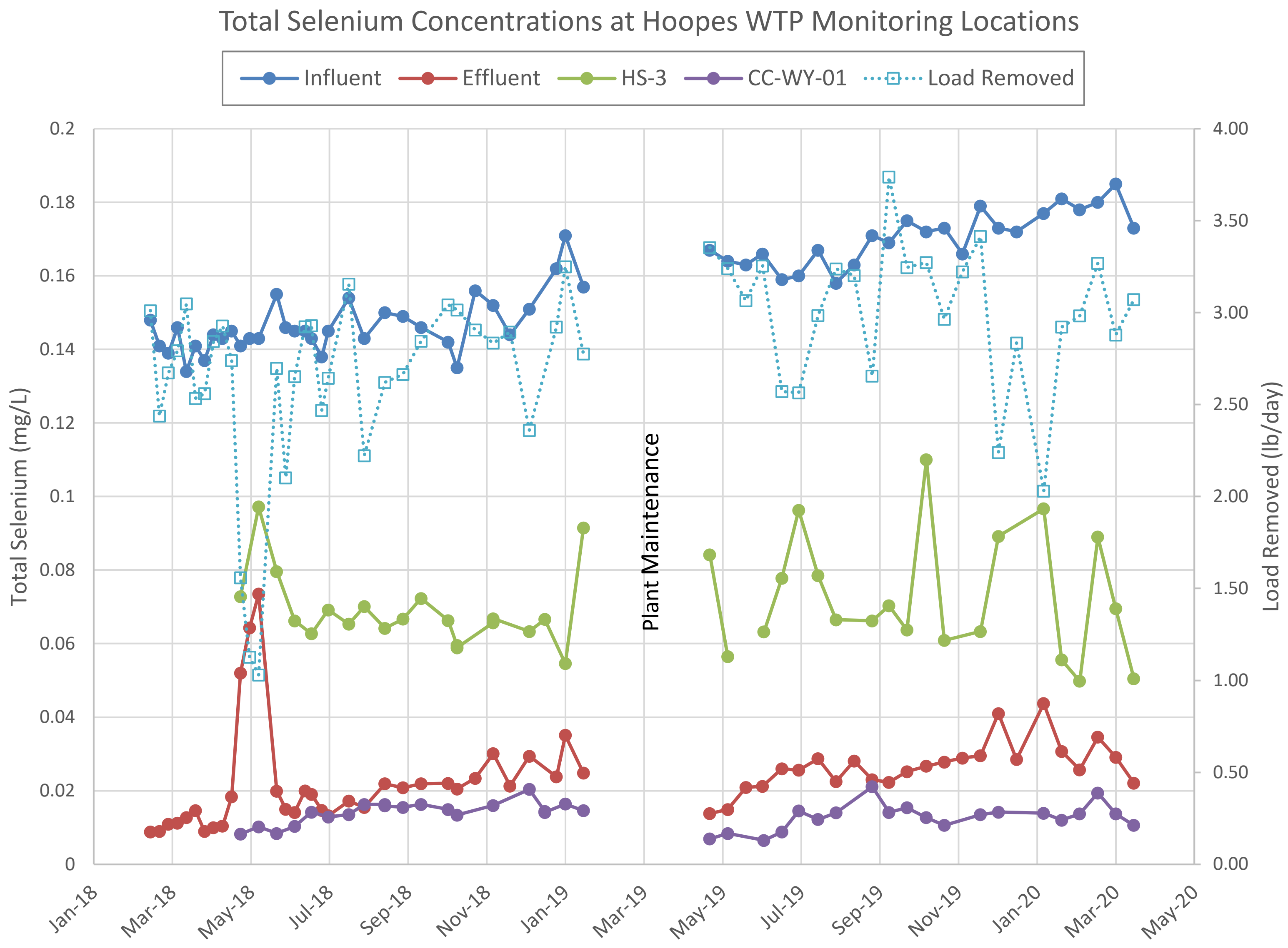

Hoopes Springs
Hoopes Treatment Pilot System
South Fork Sage

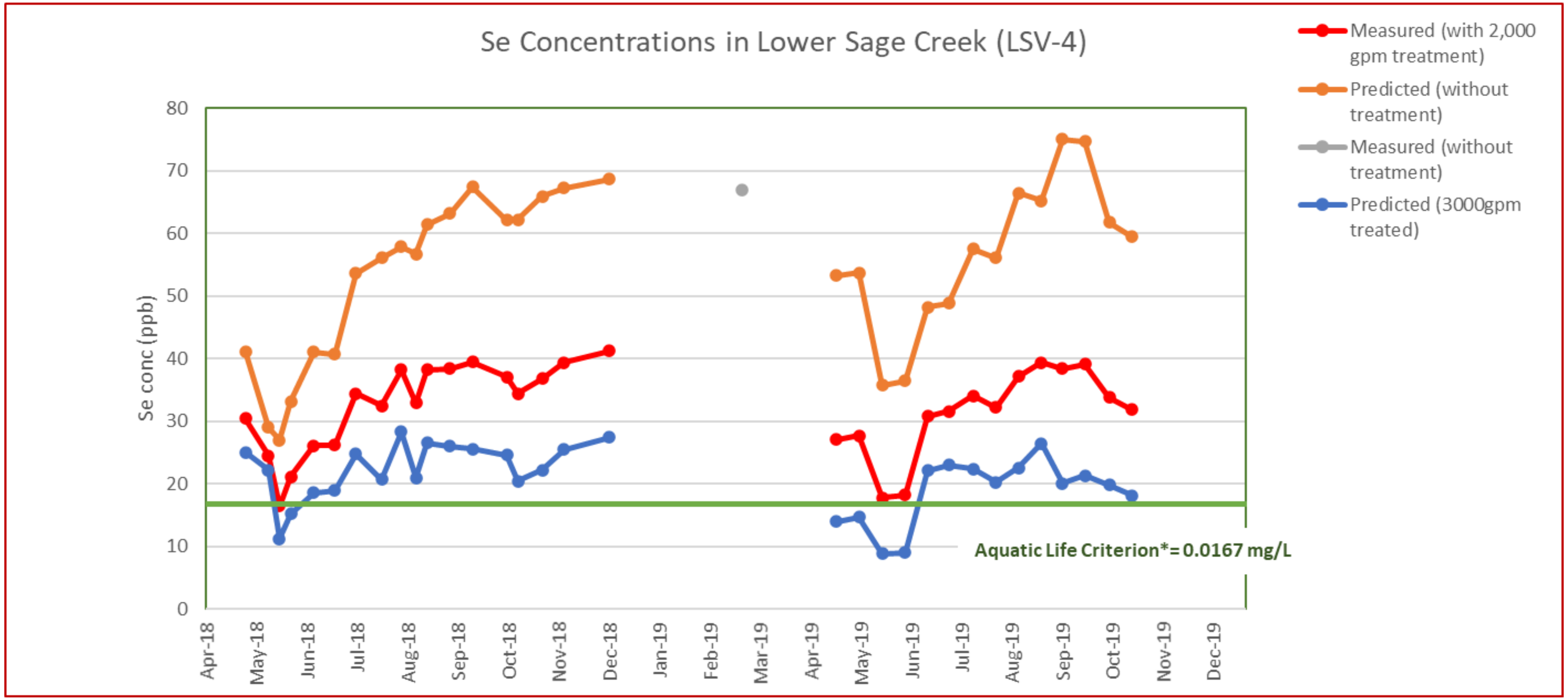
- Innovative technology for Selenium removal
  - Ultrafiltration, reverse osmosis, fluidized bed reactors for RO concentrate treatment, and post treatment system.
- Started Pilot Study at current flow configuration December 2017
- Average flow rate approximately 1,800 gpm



Water Treatment Plant Performance

- Total Selenium Influent Concentration
  - Minimum – 0.128 mg/L
  - Maximum – 0.183 mg/L
  - Average – 0.155 mg/L
- Total Selenium Effluent Concentration
  - Minimum – 0.00918 mg/L
  - Maximum – 0.0821 mg/L
  - Average – 0.0246 mg/L
- Average Percent Removal: 84%




Se Concentrations in Lower Sage Creek (LSV-4)
Measured (with 2,000 gpm treatment)
Predicted (without treatment)
Measured (without treatment)
Predicted (3000gpm treated)
Se conc (ppb)
80
70
60
50
40
30
20
10
0
Aquatic Life Criterion*=0.0167 mg/L
Apr-18
May-18
Jun-18
Jul-18
Aug-18
Sep-18
Oct-18
Nov-18
Dec-18
Jan-19
Feb-19
Mar-19
Apr-19
May-19
Jun-19
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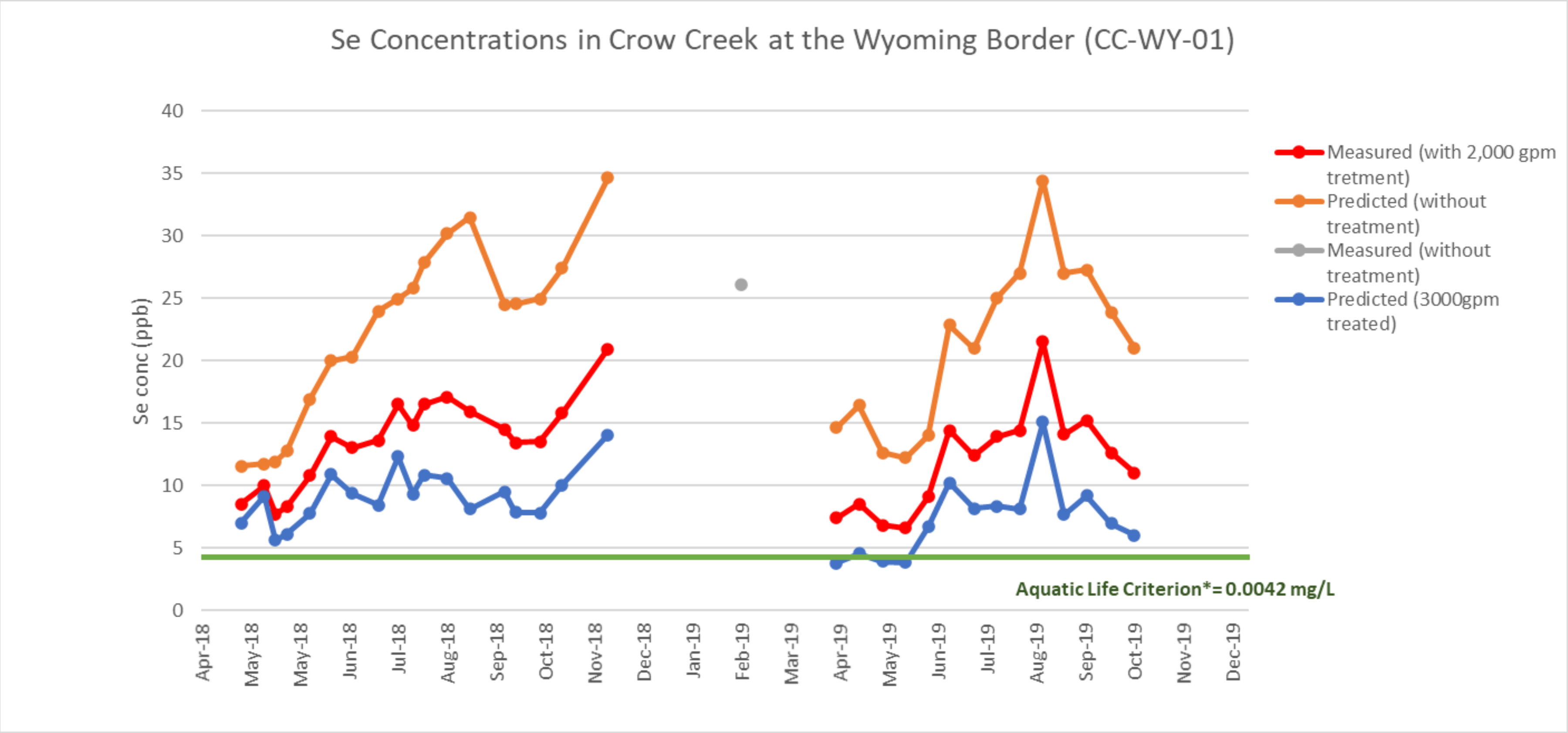
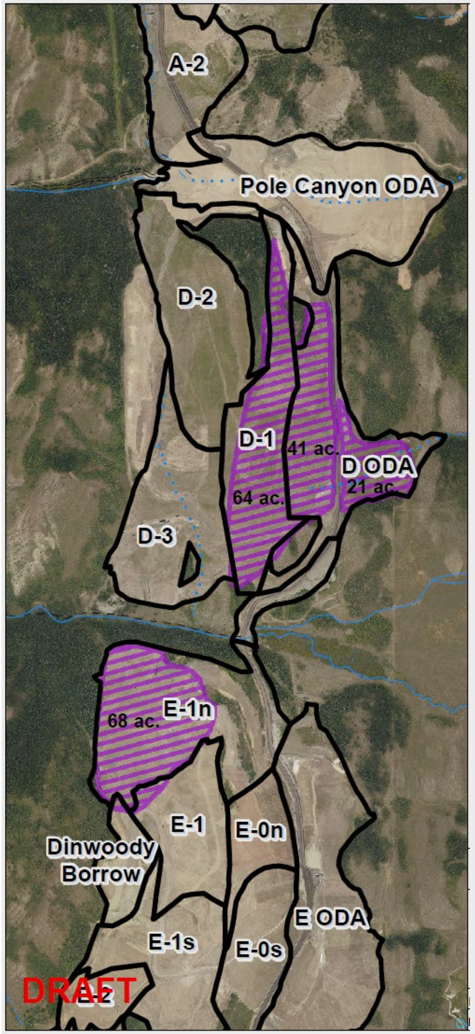
Aug-19
Sep-19
Oct-19
Nov-19
Dec-19


Se Concentrations in Crow Creek at the Wyoming Border (CC-WY-01)
Se conc (ppb)
40
35
30
25
20
15
10
5
0
Apr-18
May-18
May-18
Jun-18
Jul-18
Aug-18
Sep-18
Oct-18
Nov-18
Dec-18
Jan-19
Feb-19
Mar-19
Apr-19
May-19
Jun-19
Jul-19
Aug-19
Sep-19
Oct-19
Nov-19
Dec-19
Measured (with 2,000 gpm tretment)
Predicted (without treatment)
Measured (without treatment)
Predicted (3000gpm treated)
Aquatic Life Criterion* = 0.0042 mg/L

Rationale for Selection of ODA Areas to Be Covered



Target Cover Areas

- Target cover area rationale
  - Poor existing covers, higher infiltration
  - Proximity to springs
  - High Se overburden
- Proximity to springs
  - Panel E: 4- to 15-year travel time
  - Panel D: 14- to 23-year travel time
  - Panel A: 24- to 40-year travel time
- Panel E
  - More recent reclamation
  - Majority topsoil, Dinwoody, chert covers
- Panel A
  - Large travel time, lower Se overburden

→ D-1, E-1n, and D external ODA
- Proximity, high infiltration, high Se overburden

Capillary Covers

Capillary Cover Topics

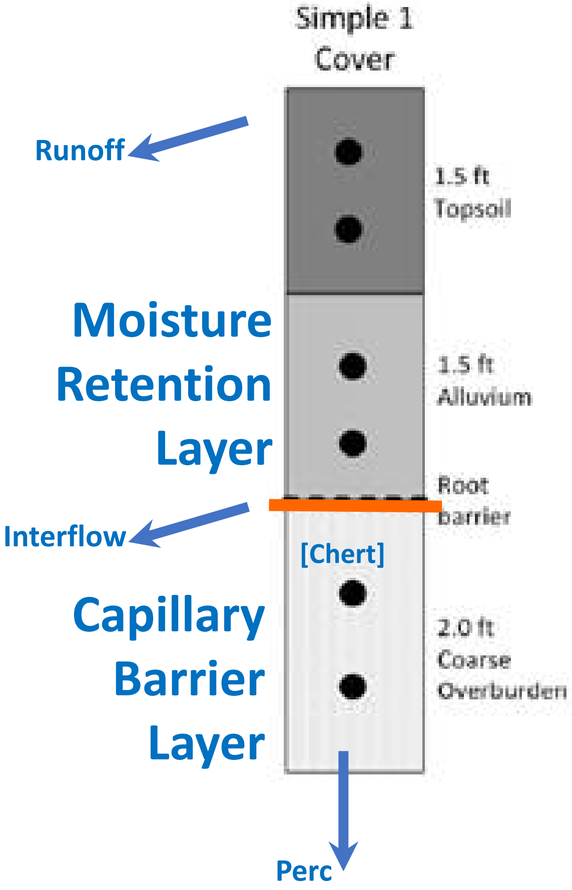
- Blackfoot Bridge Lysimeter → exploring lateral flow component
- Covers with capillary barrier effects
  - How it works
  - Estimating performance
- Preliminary performance estimate
  - Deep Dinwoody
  - Idealized Smoky materials
- Summary

Analysis Objectives

With available data (BfB, Smoky) and literature

- Develop preliminary estimates of potential performance of a cover with capillary barrier effects
- Develop rationale for groundwater model input
- Develop understanding of design considerations (e.g. materials, profile, slope) to support FS analyses

Blackfoot Bridge Lysimeter



Blackfoot Bridge - Inches

EOP Simple 1

Calendar Year	Precipitation	Runoff	Lateral Flow	ET	Δ Storage	Percolation	Lat flow%
2013	---	---	---	---	---	---	
2014	21.5	0.04	3.1	13.1	5.47	0.12	14%
2015	21.9	0.04	2.9	20.1	-2.44	0.88	13%
2016	22.3	0.04	5.6	9.6	1.89	5.07	25%
2017	41.1	0.04	10.6	15.0	-1.61	9.96	26%
2018	16.7	0	7.1	17.9	-4.65	7.78	43%
2019	20.6	0.08	4.4	22.6	3.19	4.50	21%

S:\Jobs\Smoky\CERCLA\FS\Model\Unsat\Cover_Storage_Analysis\Data_Used\Monthly_P_PET_data.xlsx

Deep Dinwoody Lysimeter

Store and Release Cover over overburden

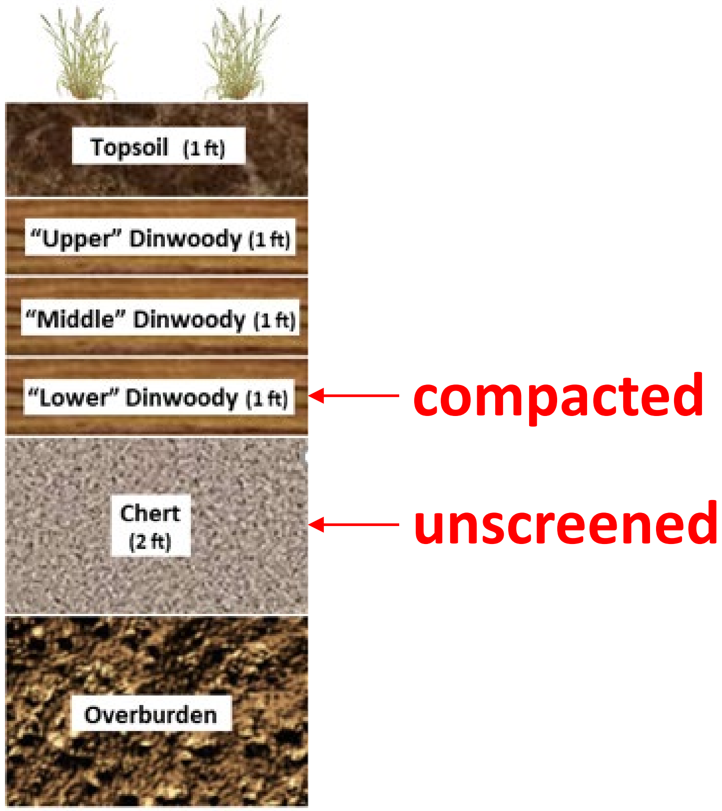


Table 7.6: 2013 – 2019 water balance analysis summary

Component	2013		2014		2015		2016		2017		2018		2019	
	Value (mm)	PPT + RO (%)	Value (mm)	PPT+ Additional Snow (%)	Value (mm)	PPT+ Additional Snow (%)	Value (mm)	PPT+ Additional Snow (%)	Value (mm)	PPT+ Additional Snow (%)	Value (mm)	PPT+ Additional Snow (%)	Value (mm)	PPT+ Additional Snow (%)
Precipitation	594	NA	737	NA	669	NA	663	NA	917	NA	532	NA	623	NA
Additional Snow	NA	NA	38	NA	72	NA	46	NA	255	NA	118	NA	49	NA
Sublimation	71	10%	43	6%	51	7%	48	7%	45	4%	76	12%	54	8%
Effective Precipitation	523	NA	732	NA	690	NA	615	NA	1127	NA	574	NA	618	NA
Potential Evapotranspiration	897	NA	912	NA	744	NA	705	NA	652	NA	703	NA	612	NA
Actual Evapotranspiration	376	53%	423	55%	464	63%	336	47%	356	30%	326	50%	358	53%
Runoff*	158	22%	71	9%	42	6%	46	6%	178	15%	48	7%	57	8%
Net Percolation	61	9%	107	14%	230	31%	228	32%	492	42%	252	39%	131	19%
Change in Storage	25	4%	48	6%	-64	-9%	26	4%	-3	< 1%	-65	-10%	53	8%
Dinwoody Interflow	10	1%	43	6%	8	1%	8	1%	17	2%	11	2%	10	1%
Topsoil Interflow	5	1%	36	4%	8	1%	5	1%	19	2%	8	1%	7	1%
Run-on*	112	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

*NOTE: Run-on contributed to the runoff value in 2013

Negligible Interflow

Terminology

- MRL — Moisture retention layer
- CBL — Capillary break layer
- CCBE — Cover with capillary barrier effect
- Breakthrough — Critical point along the interface between the fine (MRL) and coarse (CBL) layers of an inclined capillary barrier where capillary forces no longer retain the accumulated water and moisture starts to infiltrate into the coarse layer
- Diversion capacity (Q_{max}) — maximum flow a capillary barrier can divert
- Diversion length (L) — horizontal length from top of slope to breakthrough

CCBE Basics

Diversion length – with MRL and CBL properties, thickness, slope, and infiltration into cover

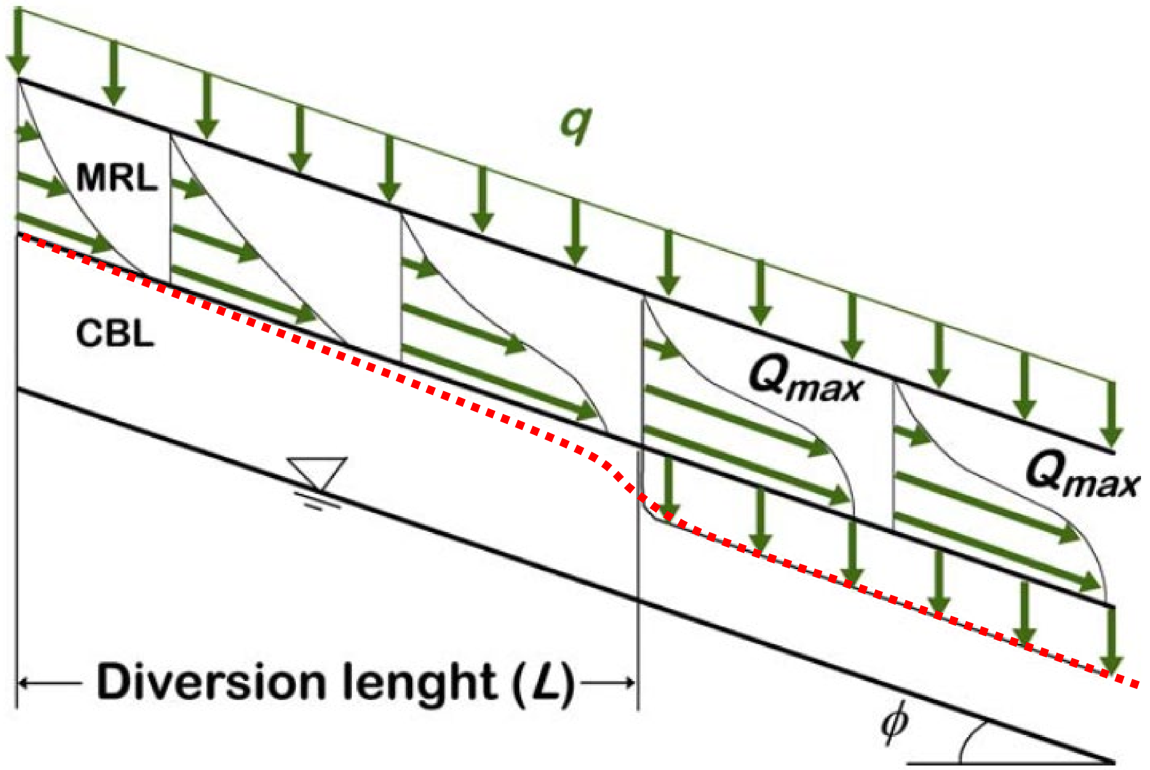


Figure 3. Schematic representation of water flow vectors in an inclined CCBE.

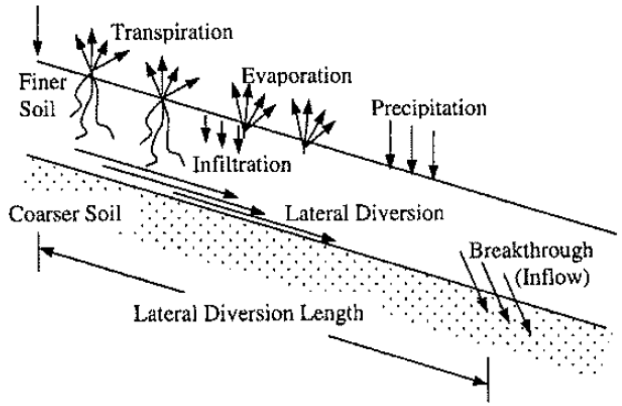


FIG. 1. Schematic of Capillary Barrier

Morris and Stormont (1999)

Literature indicates breakthrough is progressive, i.e. not 0 to Qmax (Parent and Cabral, 2006)

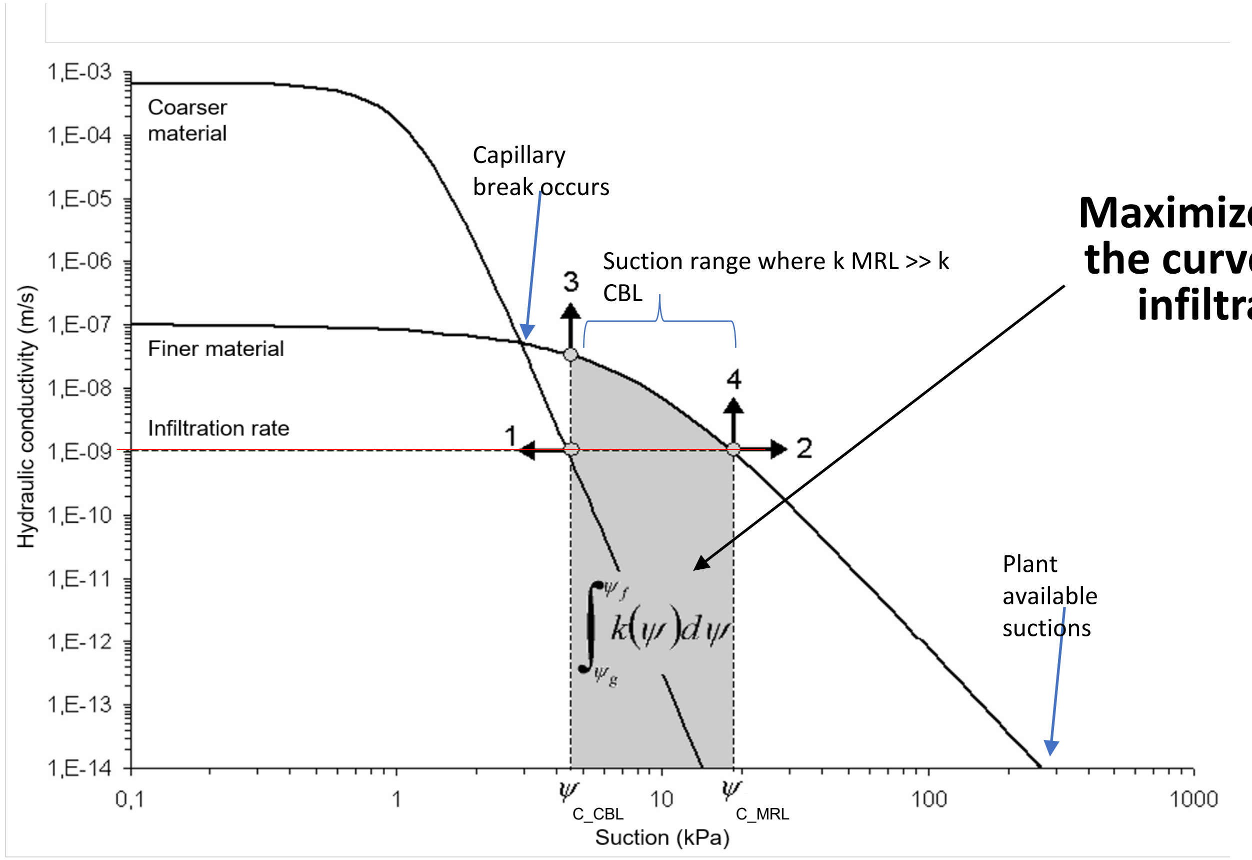
CCBE
How it works

- Gravity-driven unsaturated drainage in MRL above the CBL layer
- Water accumulates downslope--breakthrough occurs where suction is too low to retain the water
- Successful CCBEs allow unsaturated lateral drainage to occur within the MRL under a wide range of plant-accessible and drainable suctions
  - Hydraulic conductivity of MRL >> CBL
- Diversion length estimated for a given combination of materials, thickness, infiltration rate, and slope

Estimating Diversion Capacity and Length

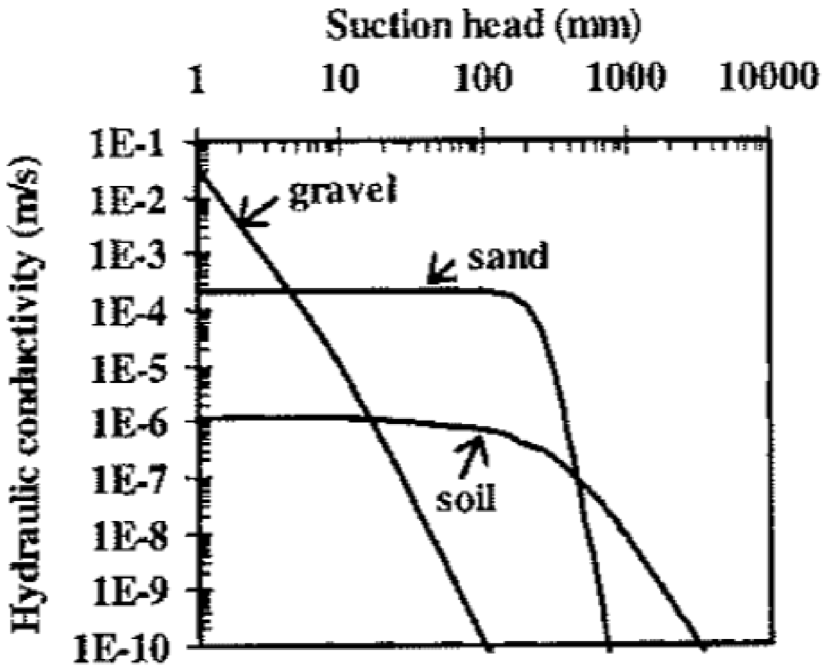
$$Q_{\max} = k_{\mathrm{sat}} \tan\phi \int_{\psi_{c\_\mathrm{CBL}}}^{\psi_{c\_\mathrm{MRL}}} k_{\mathrm{r}}(\psi)\,d\psi,$$

$$L = \frac{Q_{\max}}{q}.$$



Maximize area under the curve for a given infiltration rate

Suction vs. Hydraulic Conductivity



modified from Parent (2003)

Smoky – Idealized Materials vs. Deep Dinwoody

Dinwoody

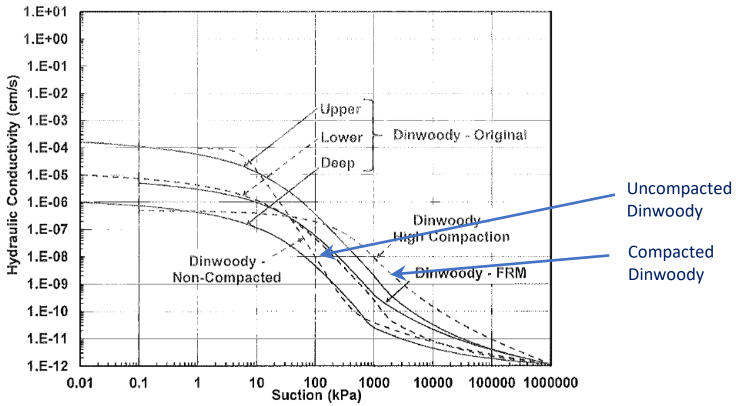


Figure A4 Hydraulic conductivity functions evaluated for the Dinwoody layers.

Chert

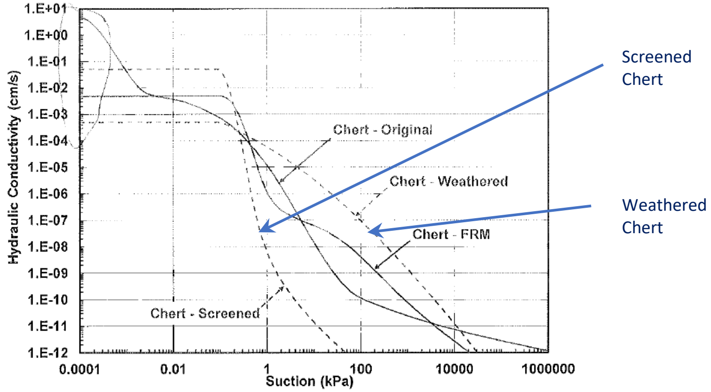
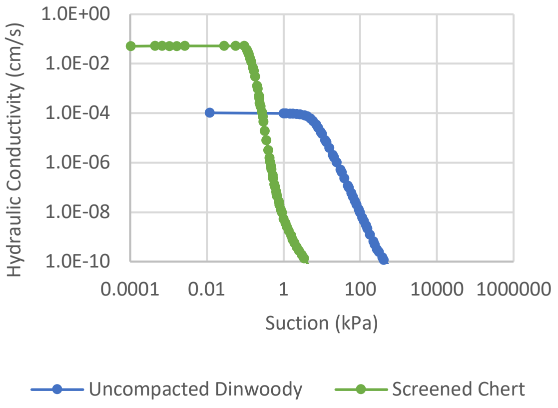


Figure A6 Hydraulic conductivity functions evaluated for the chert layer.

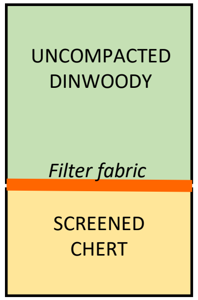
From OKC (July 9, 2015)

Idealized

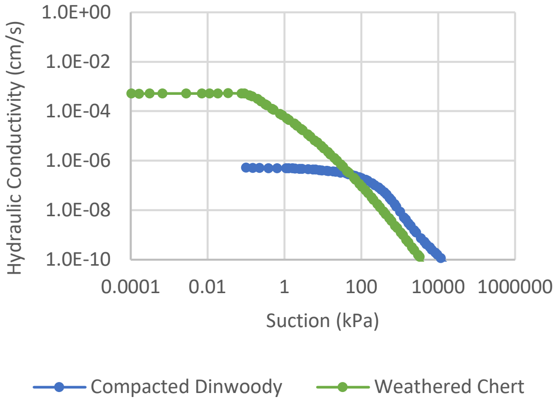


K-functions for potential capillary cover system materials

Materials and profile for potential capillary cover system

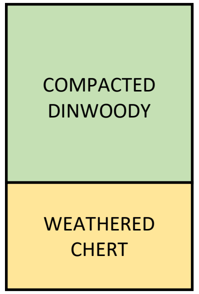


Deep Dinwoody Lysimeter



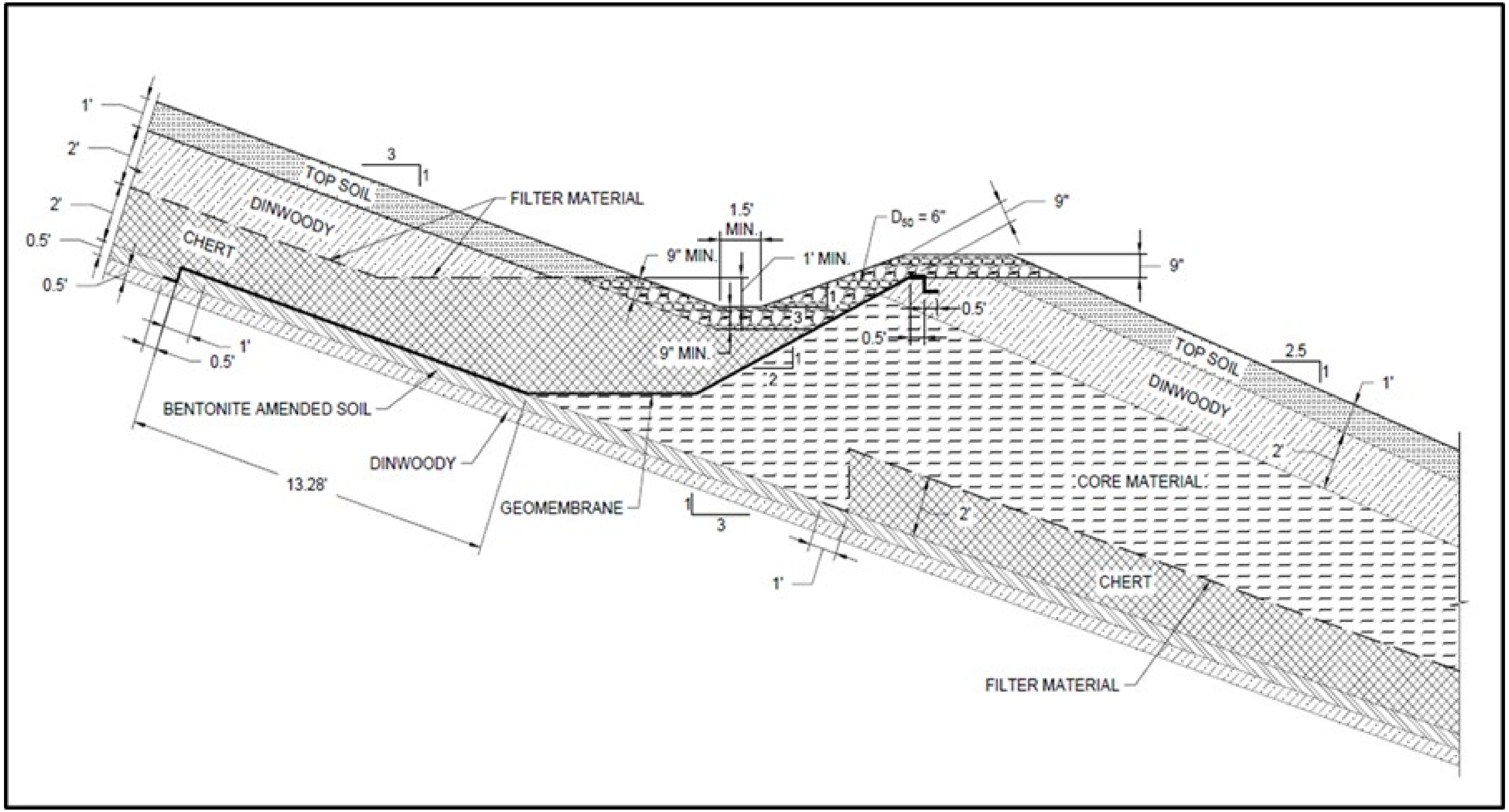
K-functions for materials not suitable for potential capillary cover system

Materials not suitable for potential capillary cover system

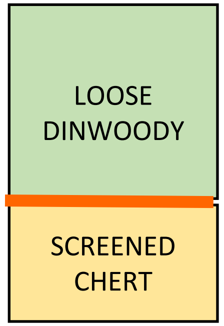


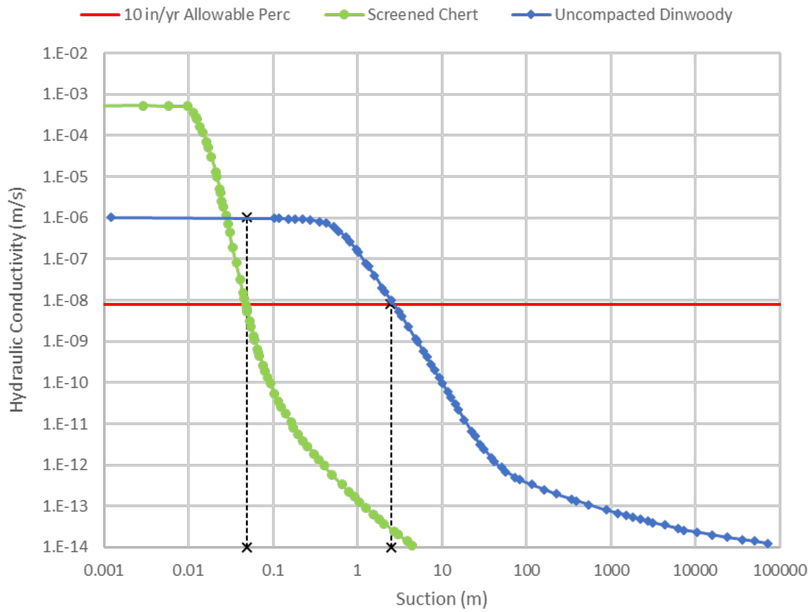
DRAINAGE BENCH DESIGN

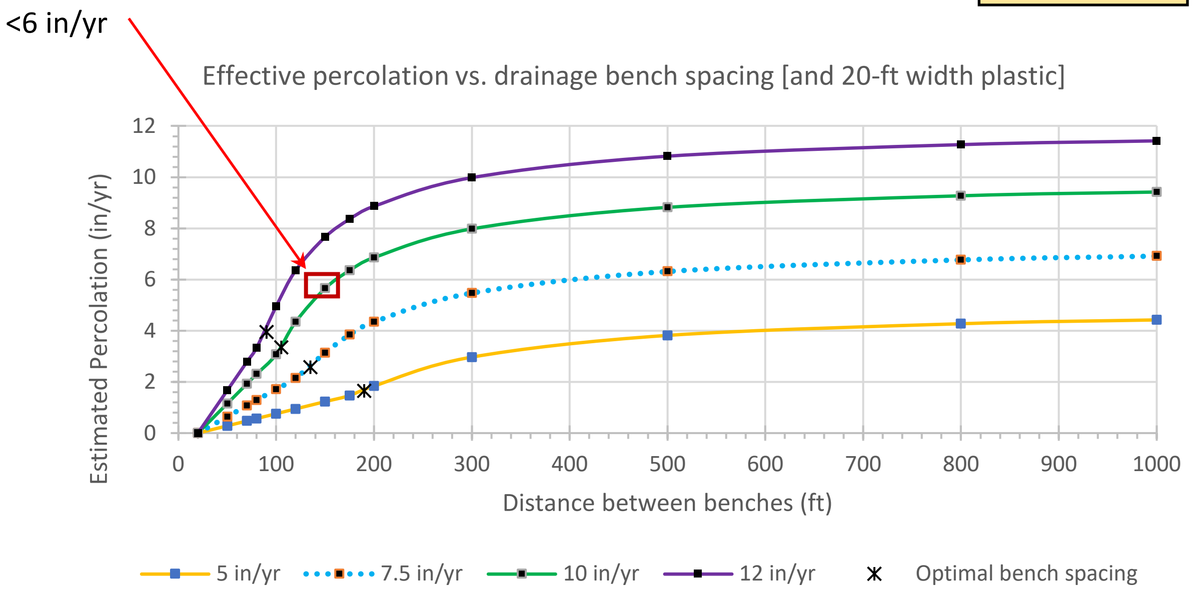
DRAINAGE BENCH CROSS-SECTION



Smoky – Preliminary estimate of capillary effects







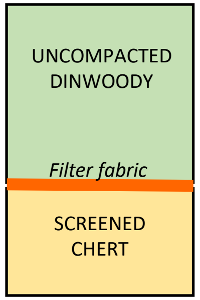
Notes:
k-functions from O'Kane (2015). The diversion capacity is proportional to the area under the blue curve between the dashed lines. The example shown is for an allowable percolation rate of 10 in/yr

Notes:
Effective percolation modified from Parent and Cabral (2006).

Capillary Cover Summary

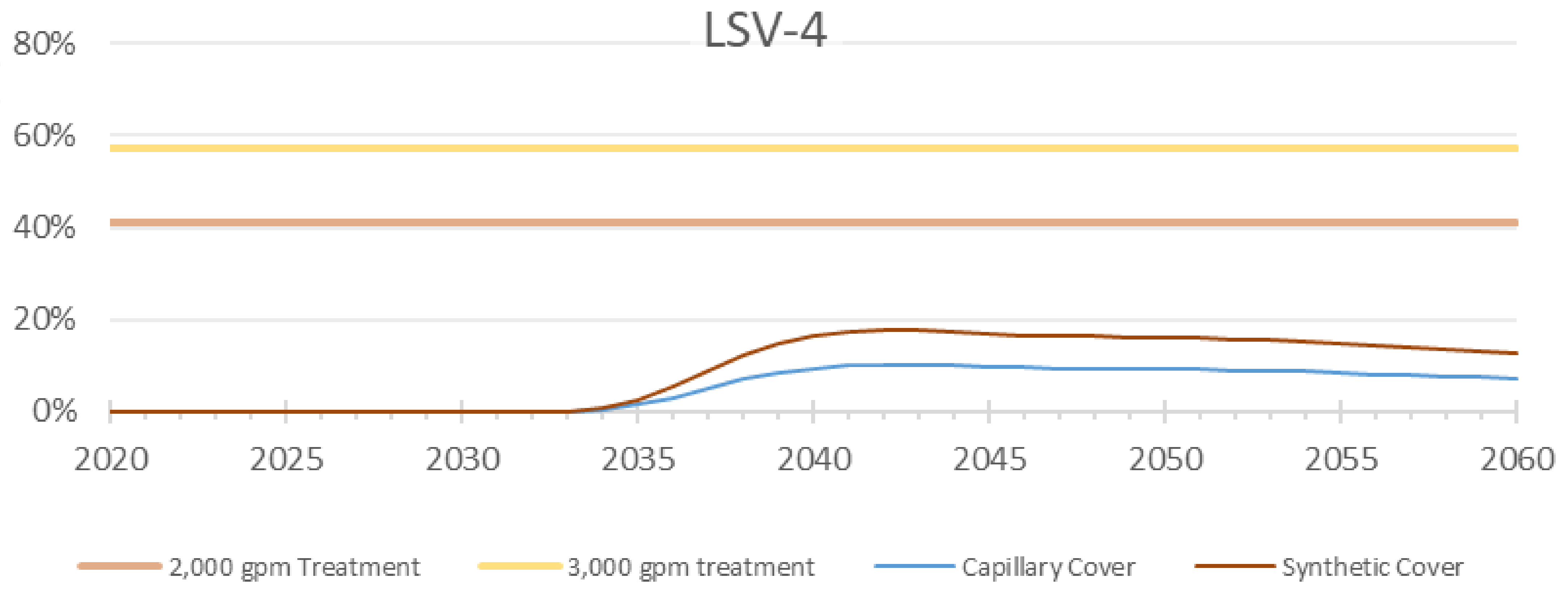
- Effects identified from newly developing BfB lysimeter monitoring
- Suitable materials available at Smoky
- Approximately 20% of the slope will have synthetic cover due to the lining of the drainage benches
- Potential to significantly reduce net infiltration with use of drainage benches at moderate costs

Materials and profile for potential capillary cover system



Outcome of Analysis

Effect of remedial actions on Se concentrations in Sage Creek – relative reduction

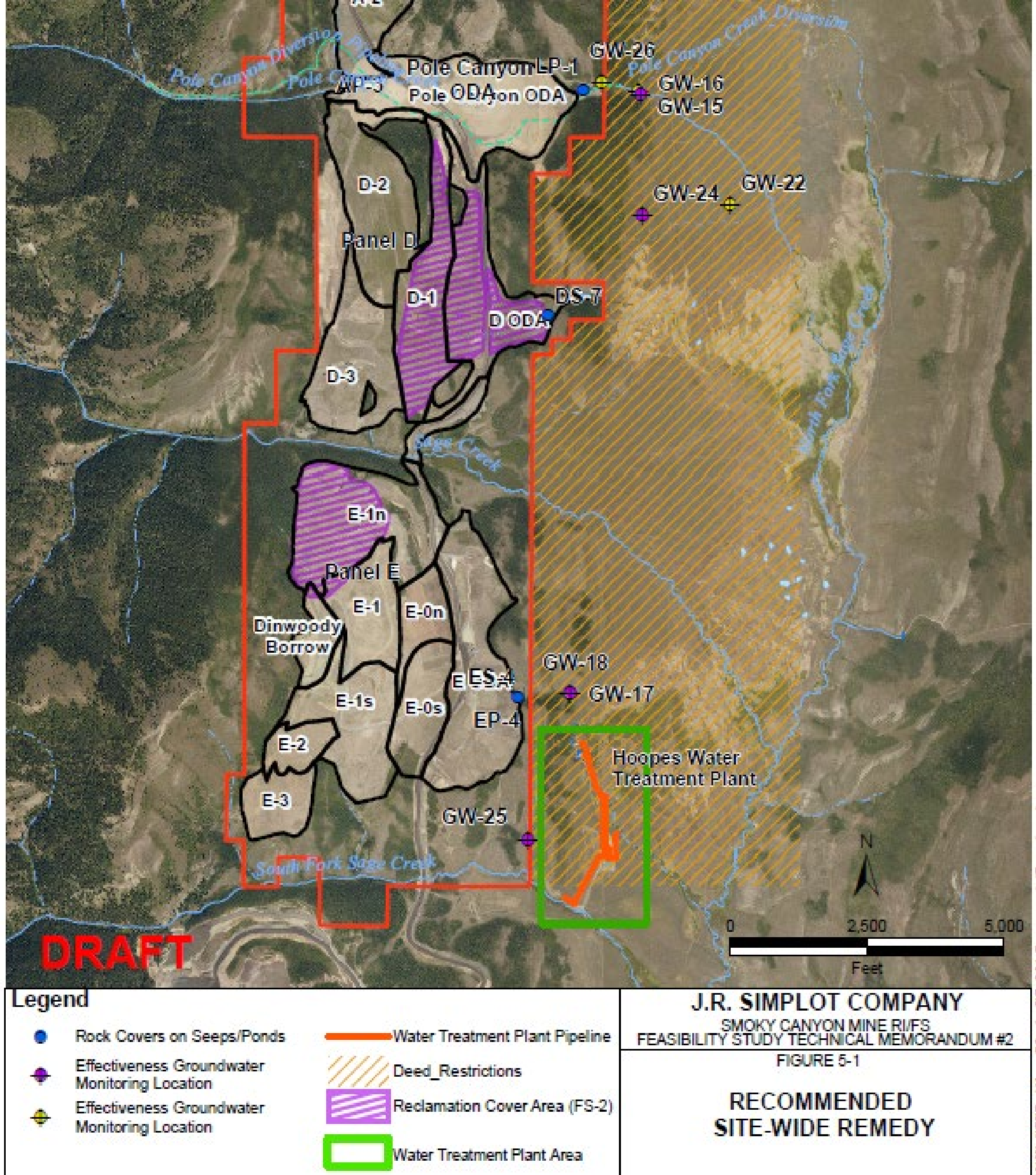


Detailed and Comparative Analysis

Wells Formation	Surface Water	Alluvial Groundwater	Soils and Solids
WG-1 No Further Action	SW-1 No Further Action	AG-1 No Further Action	S-1 No Further Action
WG-3 Institutional Controls	SW-3 Capillary Covers	AG-3 Institutional Controls (ICs) and MNA	S-2 Rock Covers on Seep and Riparian Areas
WG-5 Capillary Covers/ICs and MNA	SW-5 Geomembrane Covers	AG-4 PRB/ ICs	S-3 2-foot thick cover on ODAs
WG-7 Geomembrane Covers/ICs and MNA	SW-6 Water Treatment		
Recommended Alternative			

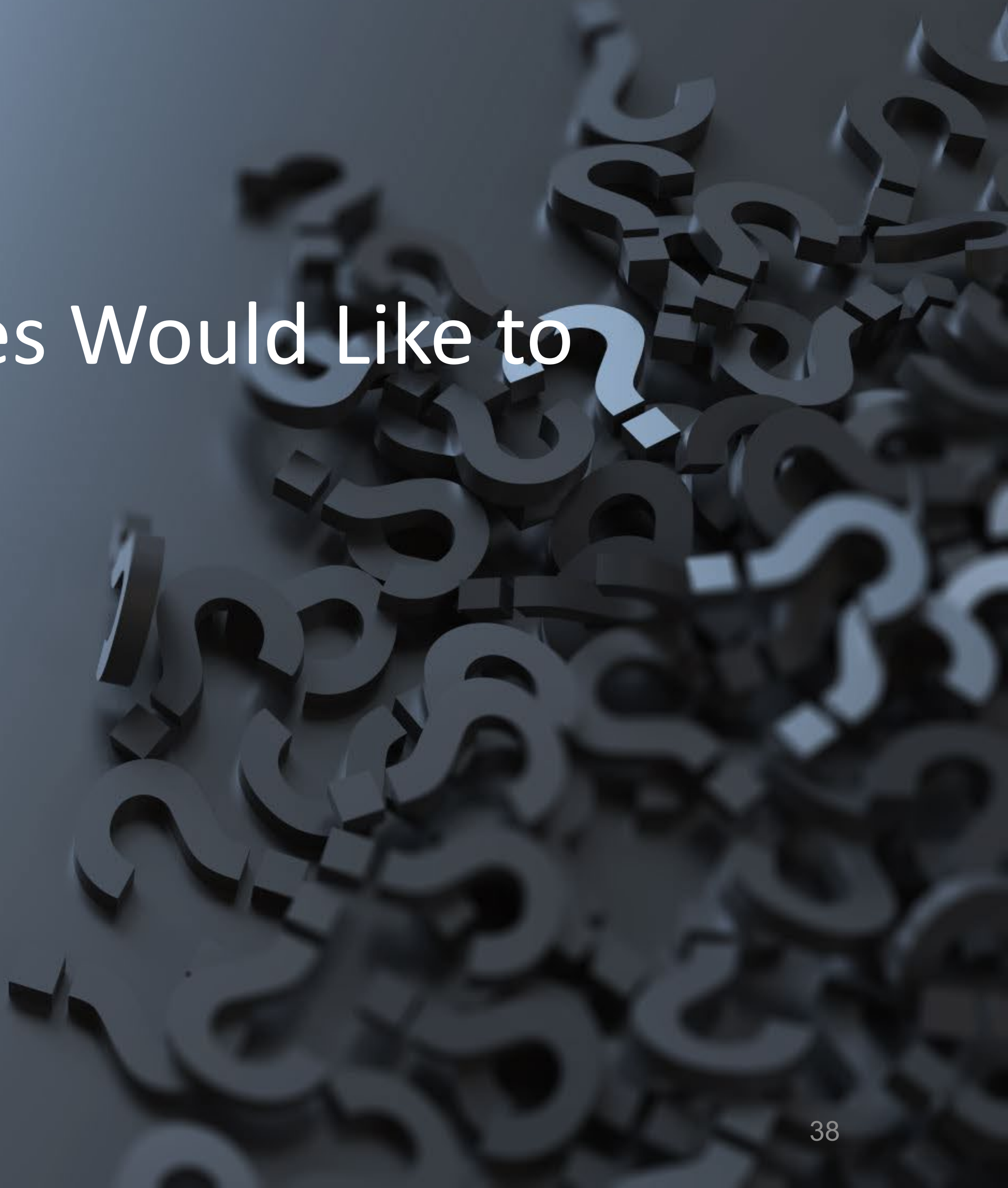
Recommended Site-Wide Remedy

- Continued operation of water treatment plant at 2,000 gpm
- Capillary Covers on target cover areas
- Deed restrictions on Simplot-owned land in Sage Valley to prevent future use of alluvial and Wells Formation groundwater with selenium concentrations above MCL for drinking water
- Long-term groundwater and surface water monitoring to evaluate monitored natural attenuation and effectiveness of remedy
- Rock covers on seeps (DS-7 and LP-1) and detention ponds to prevent (DP-7 and EP-2) to prevent people drinking the water (arsenic > MCL) (fences and signs in the interim)
- Rock covers on seep/riparian areas (AP-3, ES-4, DS-7, LP-1) to prevent small mammals and birds from contacting or ingesting soil with elevated selenium concentrations



Recommended Site-Wide Remedy

Questions/Other Issues Agencies Would Like to Discuss?



Path Forward